Instruction Manual

JOHN FLUKE MFG. CO., INC.

ECM RM 312 WS

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ELECTRONICS FOR INDUSTRY

Preliminary Operating Instructions

for

℠ MODEL 871A & 871AB

ALL SOLID-STATE

DC DIFFERENTIAL VOLTMETER

INSTRUMENTS / COMPONENTS

Serial No. 123 and above

JOHN FLUKE MFG. CO., INC.

P. O. Box 7428, Seattle 33, Washington

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SECTION I

SPECIFICATIONS

AS A DIFFERENTIAL VOLTMETER

DC ACCURACY: ±(0.03% of input voltage + 10 uv) from 0 to 1100 VDC.

VOLTAGE RANGES: 1, 10, 100, 1000VDC with 10% overvoltage capability on each range.

NULL RANGES:

Input Range	Null Ranges
1 V	0.001, 0.01, 0.1 V
10 V	0.001, 0.01, 0.1, 1 V
100 V	0.01, 0.1, 1, 10 V
1000 V	0.1, 1, 10, 100 V

DC INPUT RESISTANCE: Infinite at null from 0 to 11 VDC; 10 meghoms above 11 VDC.

METER RESOLUTION: 10 uv maximum.

VOLTAGE DIAL RESOLUTION: 10 uv xaximum.

AS A CONVENTIONAL VOLTMETER

ACCURACY: 3% of range.

RANGE:

Voltage Range	DC Input Resistance
1000-0-1000	10 Meg
100-0-100	"
10-0-10	"
1-0-1	"
*0.1-0-0.1	"
*0.01-0-0.01	"
*0.001-0-0.001	1 Meg

NOTE: 10% overvoltage capability on each range. *These ranges obtained by using null ranges with all four voltage readout dials set to zero.

GENERAL

ELECTRICAL DESIGN: Completely solid-state.

REGULATION OF REFERENCE SUPPLY: 0.001% for a 10% line voltage change.

INPUT RESISTANCE OF NULL DETECTOR: 10 megohms on two highest null ranges for all input ranges; 1 megohm on two lowest null ranges for all input ranges.

REFERENCE ELEMENT: Temperature-compensated zener diode.

DC COMMON MODE REJECTION: 130 db.

AC REJECTION:

Frequency	Normal Mode	Common Mode
50 cps	60 db	90 db
60 cps	60 db	85 db
84 cps	60 db	70 db
120 cps	70 db	80 db
400 cps	75 db	70 db
5 kc	80 db	60 db
20 kc	85 db	60 db

OPERATING TEMPERATURE RANGE: Within specifications from 55°F to 95°F. Within 0.05% from 32°F to 122°F.

STORAGE TEMPERATURE RANGE: 871A -40°F to 158°F
871AB -40°F to 140°F

KELVIN-VARLEY ACCURACY: ±0.01% of output from 1/11 of full scale to full scale.

RECORDER OUTPUT: Adjustable from 0 to ±20 mv minimum for full scale right and left deflections.

POLARITY: Selectable via front panel switch.

SHOCK AND VIBRATION: Meets requirements of MIL-T-945A.

INPUT POWER: Model 871A - 115/230 VAC ±10%, 50 - 440 cps; Model 871AB - 115/230 VAC ±10%, 50 - 440 cps and rechargeable battery operation (minimum 30 hours operation on full charge).

SIZE: 7" high x 8-1/2" wide x 11-3/4" deep.

WEIGHT: Model 871A -approximately 12 lbs.
Model 871AB -approximately 14 lbs.

SECTION II

OPERATING INSTRUCTIONS

2-1. PRELIMINARY OPERATION FOR MODEL 871A

a. Connect power plug to a 115 volt AC power source. If instrument has been wired for 230 volt operation, connect to 230 volts AC.

> NOTE: The round pin on polarized plug connects instrument case to power system ground. Use three-to-two pin adapter supplied with instrument when connecting to a two-contact receptacle. For personnel safety, connect short green lead to a good earth ground.

b. Set switches on 871A voltmeter as follows:

RANGE	1000
NULL	TVM (transistorized voltmeter)
polarity	+ (positive)
all voltage readout dials	0 (zero)

2-2. PRELIMINARY OPERATION FOR MODEL 871AB

a. For line operation, connect power plug to a 115 volt AC power source. If instrument has been wired for 230 volt operation, connect to 230 volts AC.

> NOTE: The round pin on polarized three-prong plug connects instrument case to power system ground. Use three-to-two pin adapter supplied with instrument when connecting to a two-contact receptacle. For personnel safety, connect short green lead to a good earth ground.

b. For line operation, set POWER switch to LINE OPR.

c. For battery operation, set POWER switch to BAT CHECK and wait for 10 seconds. Meter needle should indicate in BATTERY OK region. If not, charge batteries as outlined in paragraph 2-3. If batteries are charged, set POWER switch to BAT OPR-LINE ISOL.

d. Set controls on voltmeter as follows:

RANGE	1000
NULL	TVM (transistorized voltmeter)
polarity	+ (positive)
all voltage readout dials	0 (zero)

2-3. BATTERY CHARGING

a. Connect power plug to a 115 volt AC power outlet. If instrument has been wired for 230 operation, connect to 230 volts AC.

b. Set POWER switch to BAT CHG-LINE OPR. After 16 hours, batteries will be fully charged and capable of operating the instrument for at least 30 hours. While the batteries are being charged, the instrument may be operated the same as for line operation.

> CAUTION: Since overcharging decreases battery life, it is recommended that the batteries be charged for less than 48 hours and never more than 1 week. When used properly, the batteries will give more than 200 charge-discharge cycles of operation.

2-4. ZEROING INSTRUCTIONS

2-5. From time to time, it may be necessary to adjust the internal meter zero control. This will normally be done at somewhat more frequent intervals than complete instrument calibration. Proceed as follows:

a. Perform preliminary operation as stated in paragraph 2-1 or 2-2.

b. Mechanically zero the meter with the adjustment screw on the front of the meter case. If the instrument top-back cover is on, it must be shut off for at least three minutes prior to this adjustment. If the top-back cover is off, another method would be to short out the internal meter terminals prior to zeroing.

c. Set POWER switch to ON with 871A or to LINE OPR with 871AB and allow a 5 minute warmup period.

d. Set RANGE switch to 1, voltage readout dials to zero, and NULL switch to 0.001.

e. Short INPUT post to COMMON post and remove right side panel.

f. Adjust electronic zero control R227 until meter needle indicates zero when side panel is replaced.

g. Remove short between INPUT and COMMON post.

2-6. OPERATION AS A DIFFERENTIAL VOLTMETER

a. Perform preliminary operation as stated in paragraph 2-1 or 2-2.

b. Connect unknown voltage between INPUT and COMMON posts. If one side is grounded, always connect it to the COMMON post.

c. Turn RANGE switch to lowest range that will allow an on-scale reading and note approximate value of unknown voltage as indicated on meter scale.

d. If meter reads to left, turn polarity switch to negative position. Meter needle will deflect to right. This is because polarity of unknown voltage is negative.

e. Noting the position of decimal point, set four voltage readout dials to approximate voltage determined in step c. For example, if voltage is approximately 35 volts, the decimal point will be between the B and C voltage readout dials. Therefore, set A dial to 3 and B dial to 5.

f. Set NULL switch to successively more sensitive null ranges and adjust voltage readout dials for zero meter deflection in each null position. When meter needle indicates to right, magnitude of voltage under measurement is greater than voltage set on voltage readout dials. When indication is to the left, voltage is less than that set on readout dials.

g. Read unknown voltage directly from the four voltage readout dials.

2-7. OPERATION AS A CONVENTIONAL VOLTMETER

2-8. If it is desired to use the instrument only as a conventional 3% voltmeter, additional ranges can be made available by converting the NULL ranges to conventional voltmeter ranges. This is made possible by setting the voltage readout dials to zero. Proceed as follows:

a. Perform preliminary operation as stated in paragraph 2-1 or 2-2.

b. Consult figure 2-1, and select full scale voltage deflection desired. If approximate value of voltage to be measured is unknown, select 1000 volt range initially.

c. Set RANGE switch, NULL switch, and voltage dials as indicated for the range selected.

d. Connect voltage to be measured between INPUT and COMMON posts. If one side is grounded, always connect it to the COMMON post.

e. Read voltage from meter scale. Deflection to the right indicates that unknown DC voltage is of positive polarity.

END-SCALE DEFLECTION	RANGE SWITCH	NULL SWITCH	VOLTAGE DIALS
1100-0-1100	1000	TVM	No effect
110-0-110	100	TVM	No effect
11-0-11	10	TVM	No effect
1.1-0-1.1	1	TVM	No effect
0.11-0-0.11	1	0.1	All zero
0.011-0-0.011	1	0.01	All zero
0.0011-0-0.0011	1	0.001	All zero

Figure 2-1. VTVM RANGES

2-9. MEASUREMENT OF VOLTAGE EXCURSIONS ABOUT A NOMINAL VALUE

a. Perform preliminary operation as stated in paragraph 2-1 or 2-2.

b. Connect voltage to be observed between INPUT and COMMON posts. If one side is grounded, always connect it to COMMON post. Deflection to the left indicates voltage being measured is negative; set polarity switch to negative position in this case. This will cause meter needle to deflect to the right.

c. Set RANGE switch to lowest range which will give an on-scale meter indication and note nominal value of voltage indicated.

d. Set the four voltage readout dials to nominal voltage.

e. Turn NULL switch to lowest position that will allow voltage excursions to remain on scale.

f. Read voltage excursions from meter. Note that full scale right and left meter deflections are equal to the NULL range setting (disregarding 10% over-range at end of scale). Meter deflection to the right indicates that the voltage under observation has increased above the nominal value while deflection to the left indicates it has decreased.

SECTION III

CALIBRATION

3-1. GENERAL

3-2. The 871A and 871AB should be calibrated as often as deemed necessary. However, it is recommended that the instrument be calibrated every six months under ordinary laboratory conditions. For special applications where extreme accuracy is required, it may be desired to calibrate the instrument more frequently. Calibration should be accomplished under typical laboratory operating conditions in a draft free area with an ambient temperature of 72.5 (±2.5)°F for maximum accuracy.

3-3. For convenience, the calibration procedure is divided into six parts: Preliminary Calibration, Null Detector Calibration, 10 Volt Range Calibration, 1 Volt Range Calibration, 100 Volt Range Calibration, and 1000 Volt Range Calibration. Calibration is normally done by performing all six parts in the sequence given here. However, the calibration procedure is written so that any section may be calibrated by performing the calibration procedure for that section after performing the preliminary calibration procedure. The recommended equipment and the specifications required for calibration are shown in figure 3-1.

RECOMMENDED EQUIPMENT	SPECFICATIONS REQUIRED
DC Power Supply with an output of 0 to 1000 volts. Standard cell with an accuracy of ±0.002%. Voltage reference divider having division ratios of 1, 10, 100, and 1000 with an accuracy of ±0.003%. Galvanometer suitable for use with above voltage reference divider	The equipment used must provide 1000, 100, 10, and 1 volt with an accuracy of ±(0.005% + 5 uv).

Figure 3-1. CALIBRATION EQUIPMENT

3-4. PRELIMINARY CALIBRATION

a. Set meter to zero with mechanical zero control.
b. Set switches on 871 as follows:

RANGE	1
NULL	0.001
polarity	+ (positive)
all voltage readout dials	0 (zero)

c. Set POWER switch to ON with 871A or to LINE OPR with 871AB and allow instrument to warmup to equilibrium temperature (about 10 minutes).
d. Set up the necessary equipment to provide DC voltages of 1000, 100, 10, and 1 volts with an accuracy of ±(0.005% + 5 uv). Proceed as follows: Turn on all test equipment and allow it to warmup to equilibrium temperature (about 1/2 hour); connect galvanometer and standard cell bank in series to standard cell terminals of divider; set proper standard cell voltage on divider; apply 1000 volts DC into 1000 volt input terminal of divider; zero galvanometer by varying output of power supply; voltages of 1000, 100, 10, and 1 volts DC ±(0.005% + 5 uv) are available at the corresponding output terminals.
e. Connect CHASSIS ground post to line ground.
f. Remove top panel of voltmeter.

3-5. NULL DETECTOR CALIBRATION

a. Short INPUT post to COMMON post and remove right side panel.
b. Adjust electronic zero control R227 until meter needle indicates zero when side panel is replaced.
c. Set voltage readout dial C to 1.
d. Adjust tvm gain adjust control R231 until meter needle indicates full scale deflection to the left (disregarding 10% over-range at end of scale), when side panel is replaced.
e. Remove short between INPUT and COMMON posts.

3-6. 10 VOLT RANGE CALIBRATION

a. Set switches on 871 as follows:

RANGE	10
NULL	1
voltage readout dials	10.0000

b. Apply 10 volts DC (±0.005%) between INPUT and COMMON posts.
c. Adjust R119 for zero meter deflection in each successively more sensitive null range.

3-7. 1 VOLT RANGE CALIBRATION

a. Set switches on 871 as follows:

RANGE	1
NULL	.1
voltage readout dials	1.00000

b. Apply 1 volt DC ±(0.005% + 5 uv) between INPUT and COMMON posts.
c. Adjust R121 for zero meter deflection in each successively more sensitive null range.

3-8. 100 VOLT RANGE CALIBRATION

a. Set switches on 871 as follows:

RANGE	100
NULL	10
voltage readout dials	100.000

b. Apply 100 volts DC (±0.005%) between INPUT and COMMON posts. Note that calibration power supply must be readjusted for a galvanometer null due to loading of voltmeter on voltage reference divider.
c. Adjust R104 for zero meter deflection in each successively more sensitive null range.

3-9. 1000 VOLT RANGE CALIBRATION

a. Set switches on 871 as follows:

RANGE	1.000
NULL	100
voltage readout dials	1000.00

b. Apply 1000 volts DC (±0.005%) between INPUT and COMMON posts.
c. Adjust R106 for zero meter deflection in each successively more sensitive null range.

WARRANTY

The JOHN FLUKE MFG. CO., INC. warrants each instrument manufactured by them to be free from defects in material and workmanship. Their obligation under this Warranty is limited to servicing or adjusting an instrument returned to the factory for that purpose, and to making good at the factory any part or parts thereof; except tubes, fuses, choppers and batteries, which shall, within one year after making delivery to the original purchaser, be returned by the original purchaser with transportation charges prepaid, and which upon their examination shall disclose to their satisfaction to have been thus defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at a nominal cost. In this case, an estimate will be submitted before work is started, if requested.

If any fault develops, the following steps should be taken.

1. Notify the John Fluke Mfg. Co., Inc., giving full details of the difficulty, and include the Model number, type number, and serial number. On receipt of this information, service data or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument prepaid, and repairs will be made at the factory. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the Warranty.

SHIPPING

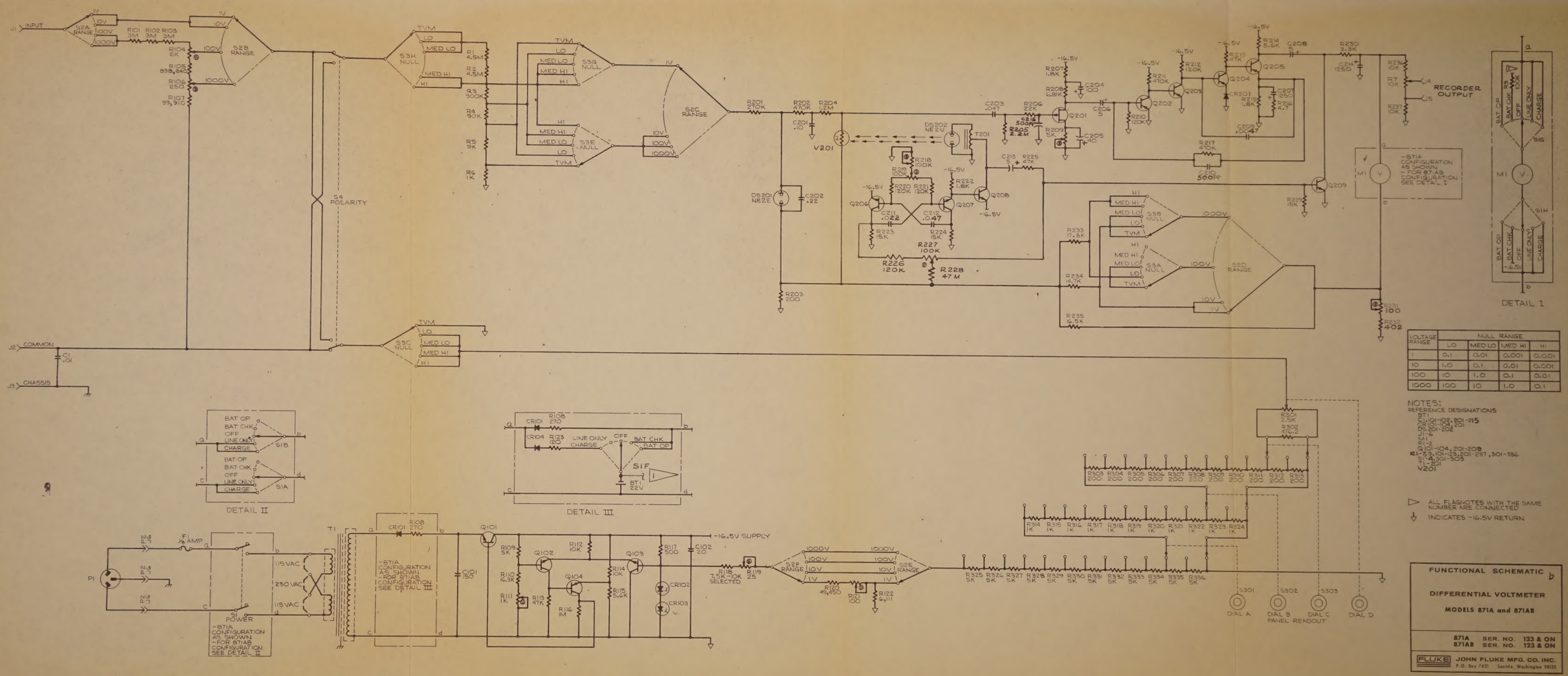
All shipments of John Fluke Mfg. Co., Inc. instruments should be made via Railway Express prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be thoroughly inspected immediately upon receipt. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to John Fluke Mfg. Co., Inc. Upon receipt of this report you will be advised of the disposition of the equipment for repair or replacement. Include the model number, type number, and serial number when referring to this instrument for any reason.

The John Fluke Mfg. Co., Inc. will be happy to answer all application questions which will enhance your use of this instrument. Please address your requests to:

JOHN FLUKE MFG. CO., INC., P. O. BOX 7428, SEATTLE 33, WASHINGTON



VOLTAGE RANGE	NULL RANGE			
	LO	MED LO	MED HI	HI
	0.1	0.01	0.001	0.001
10	1.0	0.1	0.01	0.001
100	10	1.0	0.1	0.01
1000	100	10	1.0	0.1

NOTES:

REFERENCE DESIGNATIONS
BT1
C-101-102, 201-215
CR101-104, 201
DS-201-202
J1-4
M1
P1-2
Q101-104, 201-209
R1-3, 101-128, 201-257, 301-336
S-1, 301-303
T-201
V201

▷ ALL FLAGNOTES WITH THE SAME NUMBER ARE CONNECTED

⏚ INDICATES -16.5V RETURN.

FUNCTIONAL SCHEMATIC b

DIFFERENTIAL VOLTMETER

MODELS 871A and 871AB

871A SER. NO. 123 & ON
871AB SER. NO. 123 & ON

FLUKE JOHN FLUKE MFG. CO. INC.
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